PETER MELCHIOR (PRINCETON)

WFIRST & LSST

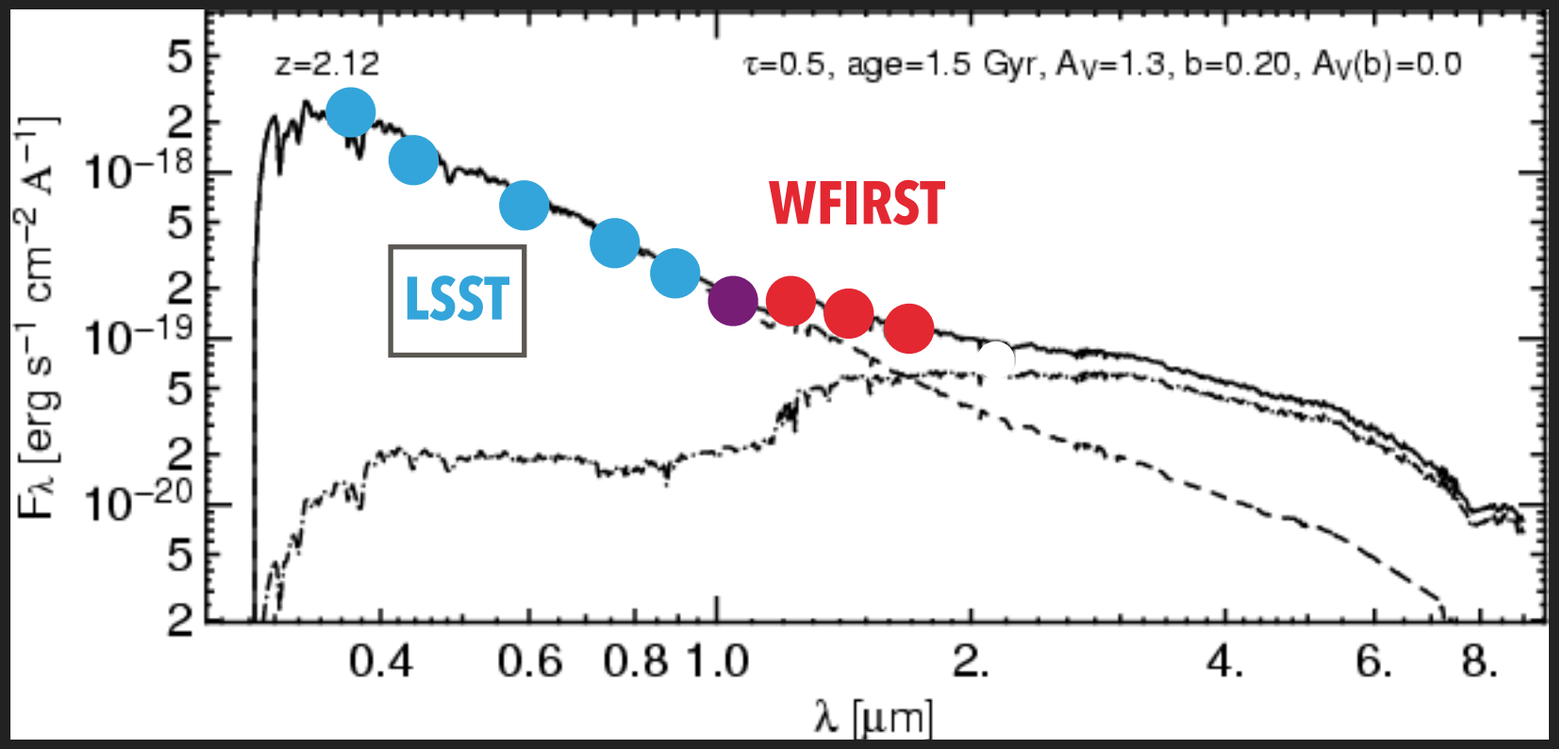
THE CASE FOR GROUND & SPACE

DES data from Melchior et al. (2015)

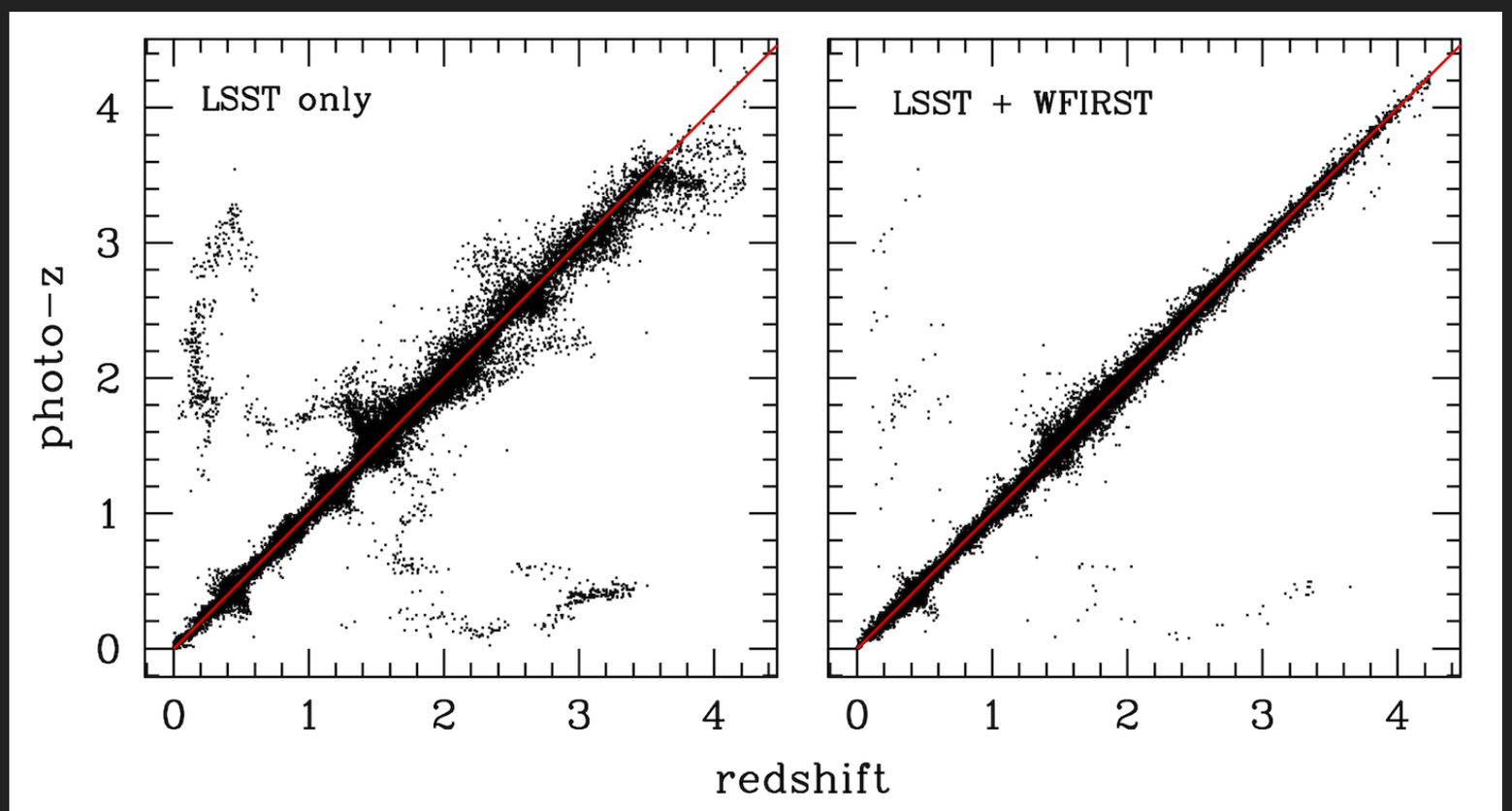
THE CASE FOR GROUND & SPACE

CLASH WFC3/IR data, image by Dan Coe

SYNERGIES FOR PHOTOMETRY / PHOTO-Z



from Elsner (2008)



from Jain et al. (2015)

BLENDING

PHOTOMETRY WITH BLENDS

- Aperture fluxes do not work!
- Deblender must disambiguate galaxies vs stars vs moving objects
- That deblender is as complicated as a model fitter
- Once detection is done: deblending is as hard as model fitting

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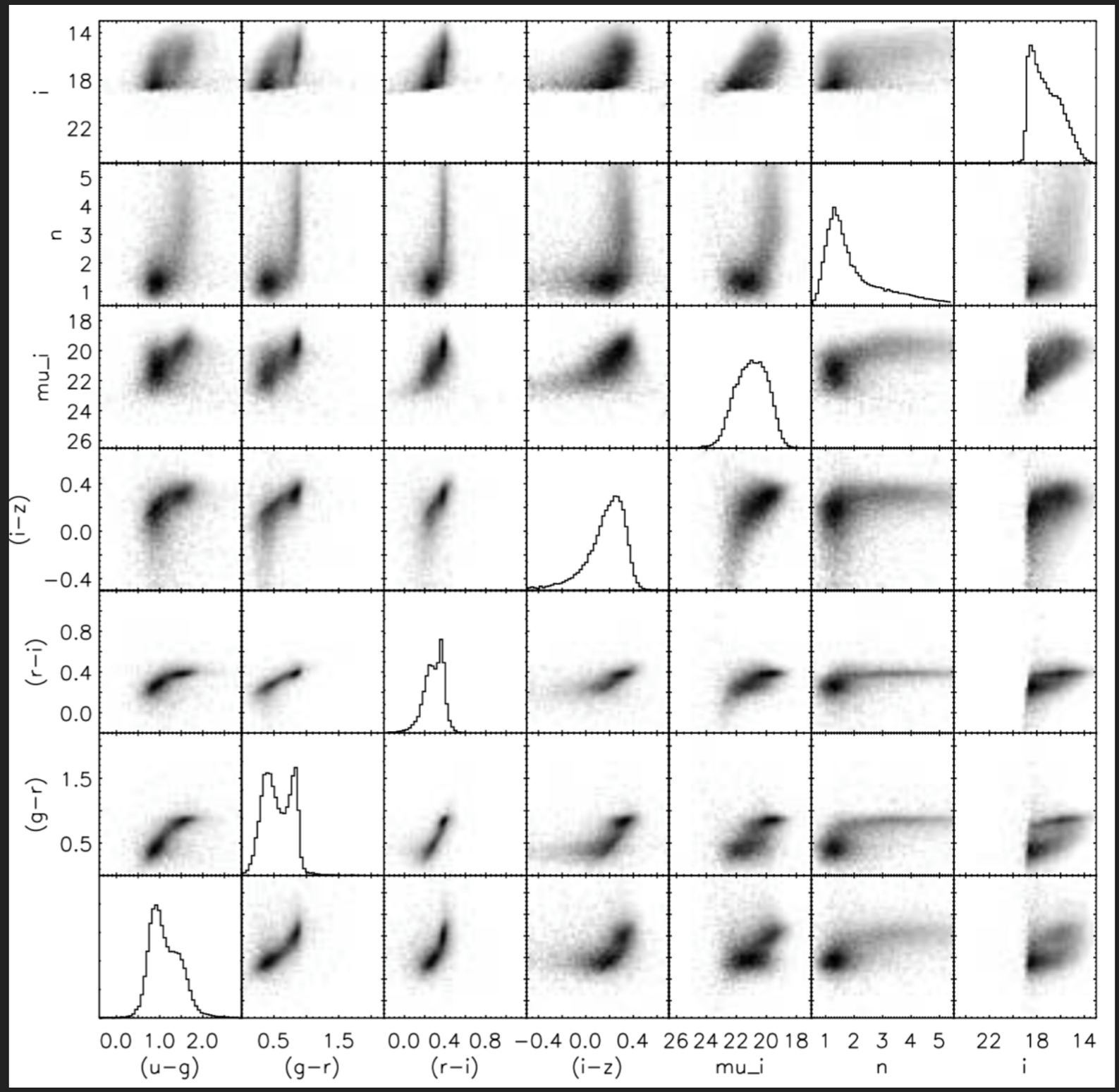
- Model fitting can do a lot simultaneously (e.g. DCR)
- Model fitting can include detection
- Models for blended objects are unstable!

COLOR – MORPHOLOGY RELATIONS

Source: wikipedia.org

MORPHOLOGY FOR PHOTO-Z'S

- Wray & Gunn (2008)
- joint galaxy relations exist (at low z)
- photo-z's can be improved by factor ~1.5 with
  - luminosity
  - Sersic index
  - surface brightness



PHOTOMETRY AND SHAPE PARAMETERS

- General estimator: $p(\theta \mid D) \propto p(D \mid \theta)\ p(\theta)$
- Single band: $p(A_b, \theta_b \mid D_b) \propto p(D_b \mid A_b, \theta_b)\ p(\theta_b)$
- Multiple bands: 1) $p(A, \theta \mid D) \propto \prod_b p(D_b \mid A_b, \theta_b)\ p(\theta_b)$

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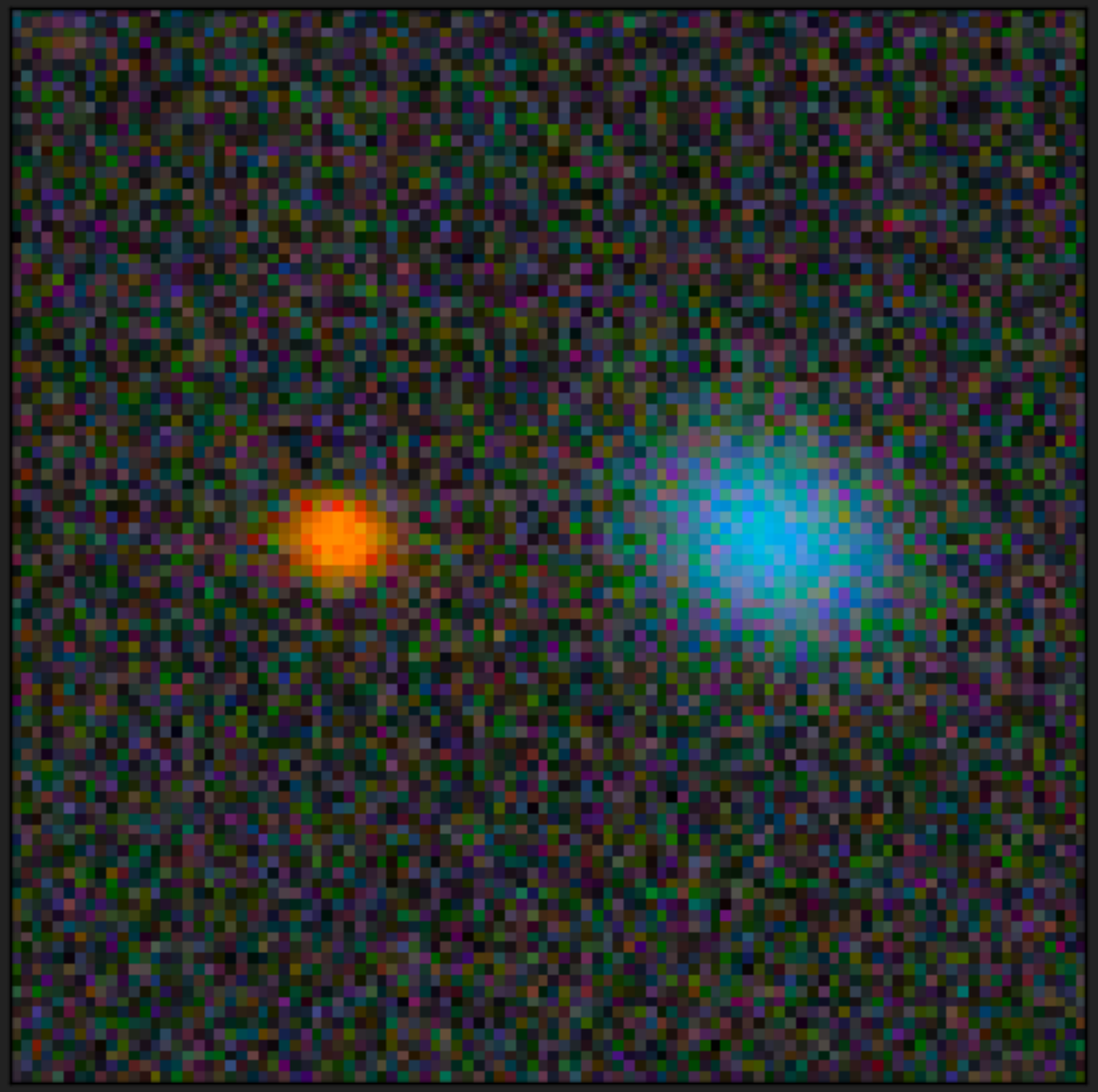
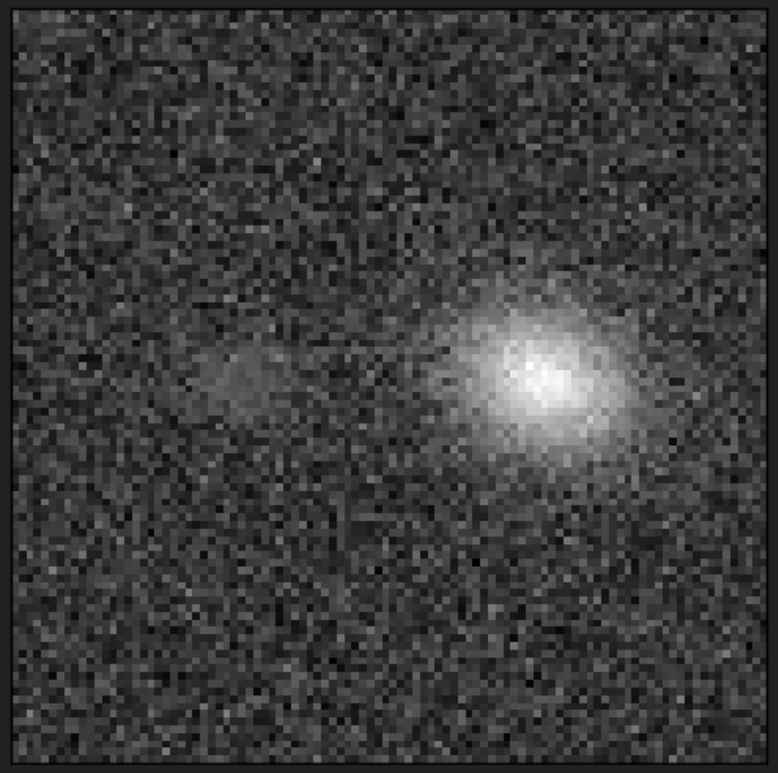
A SIMPLE TEST CASE FOR SHAPE & PHOTO-Z

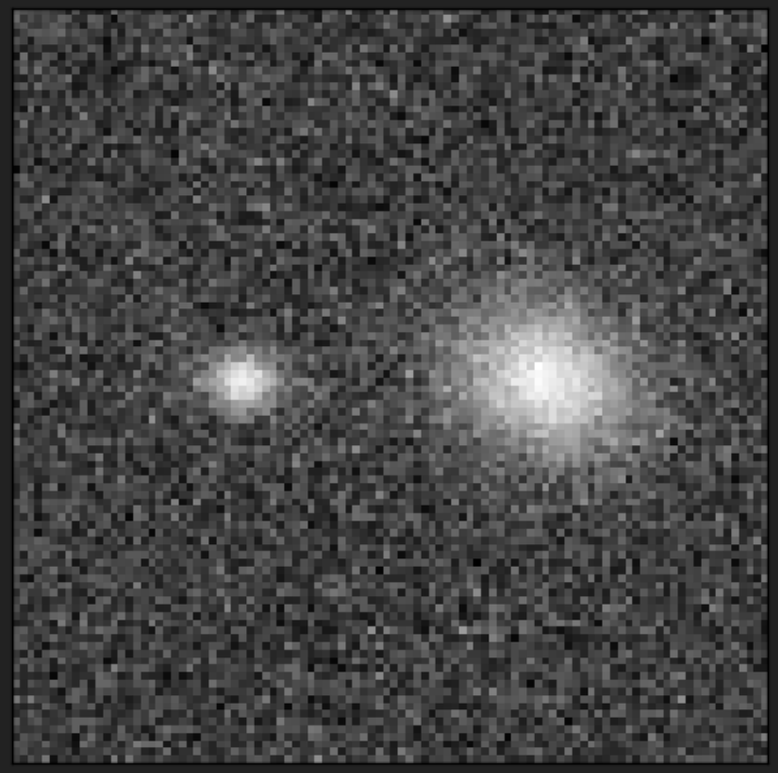
- single Sersic-type galaxies, convolved with constant Gaussian PSF
- SEDs and morphologies from late-type and early-type galaxy
- simple template redshifts



1) INDEPENDENT MEASUREMENTS

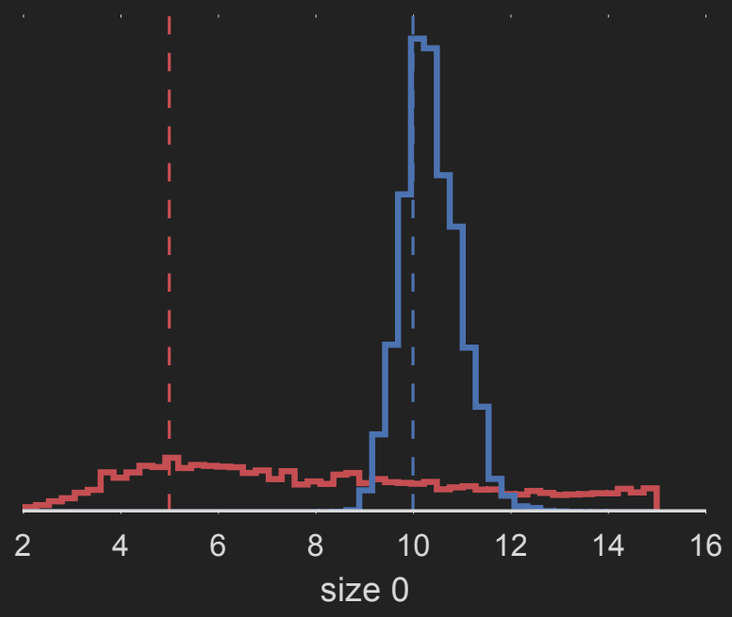


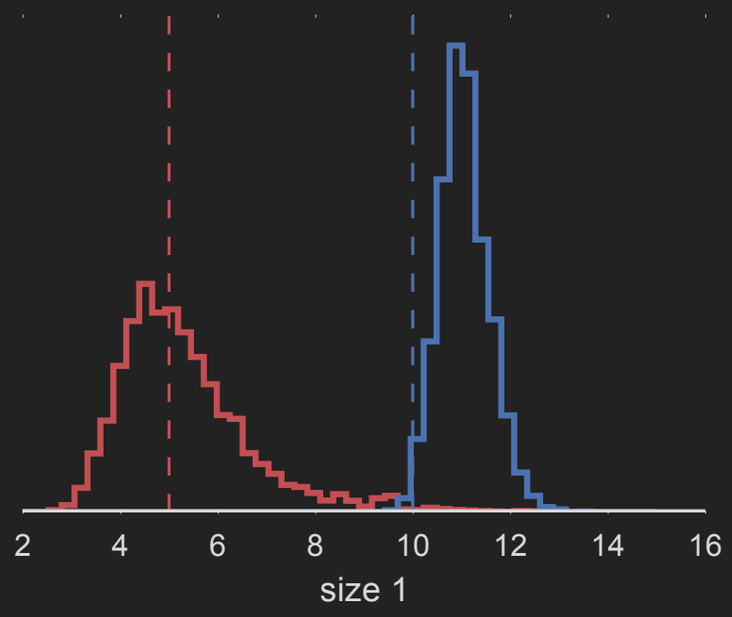
g band

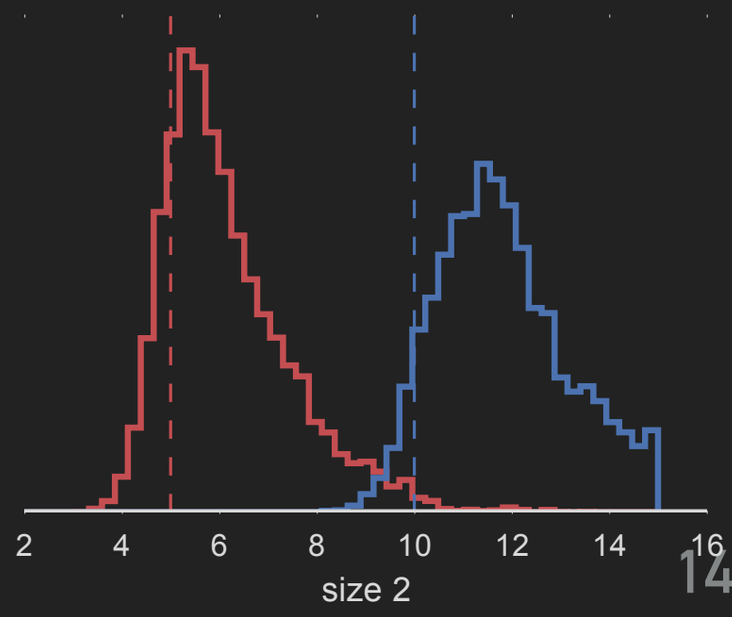


r band

i band







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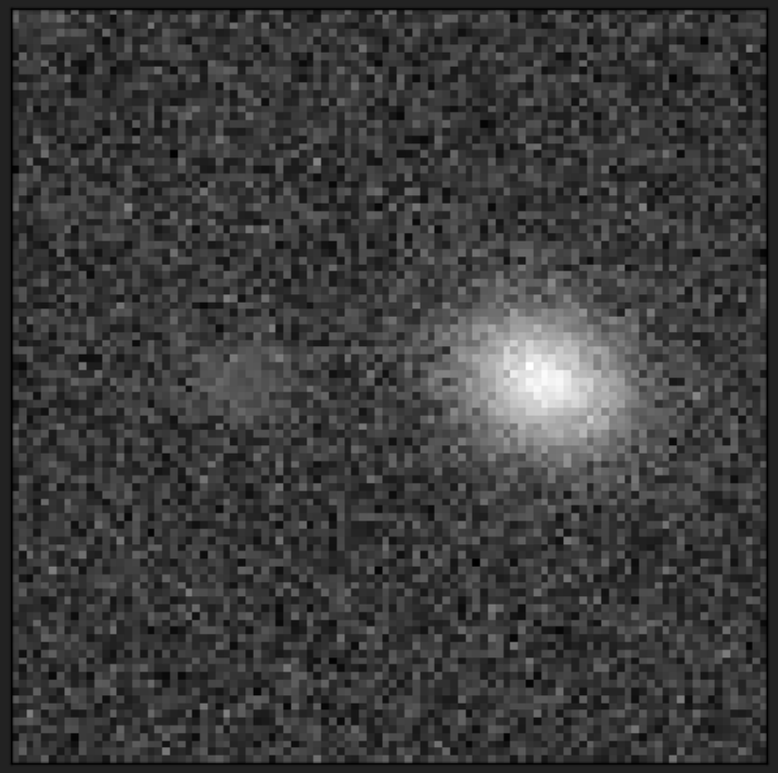

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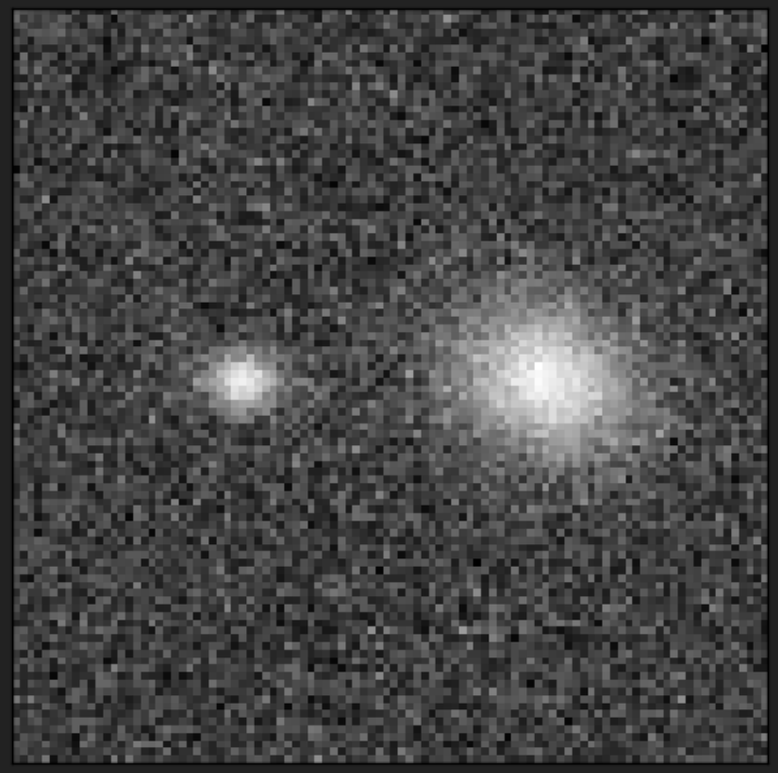

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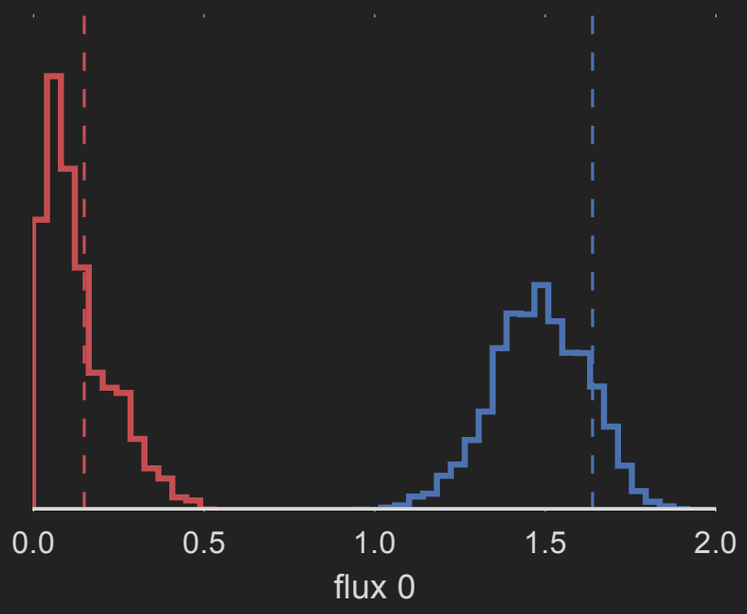
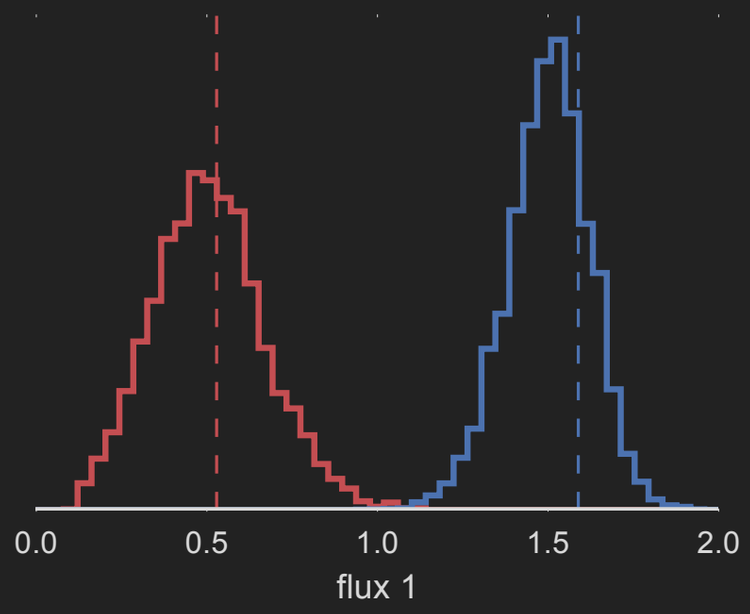
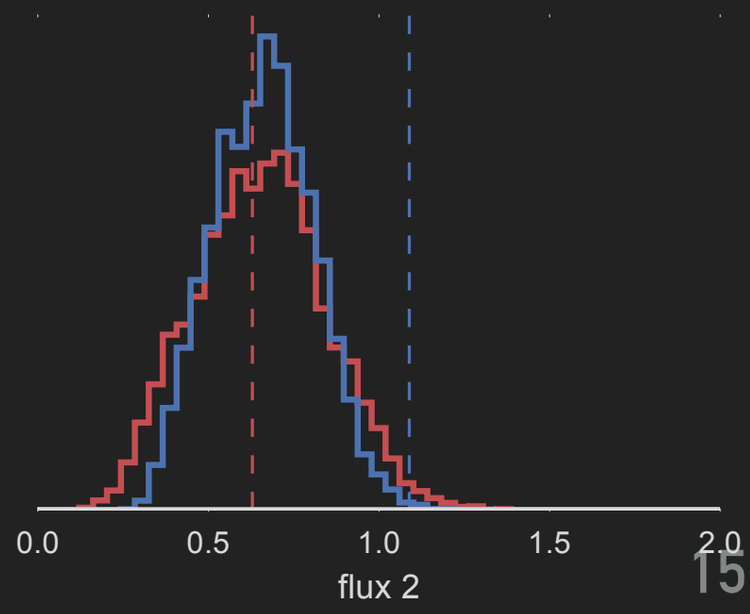
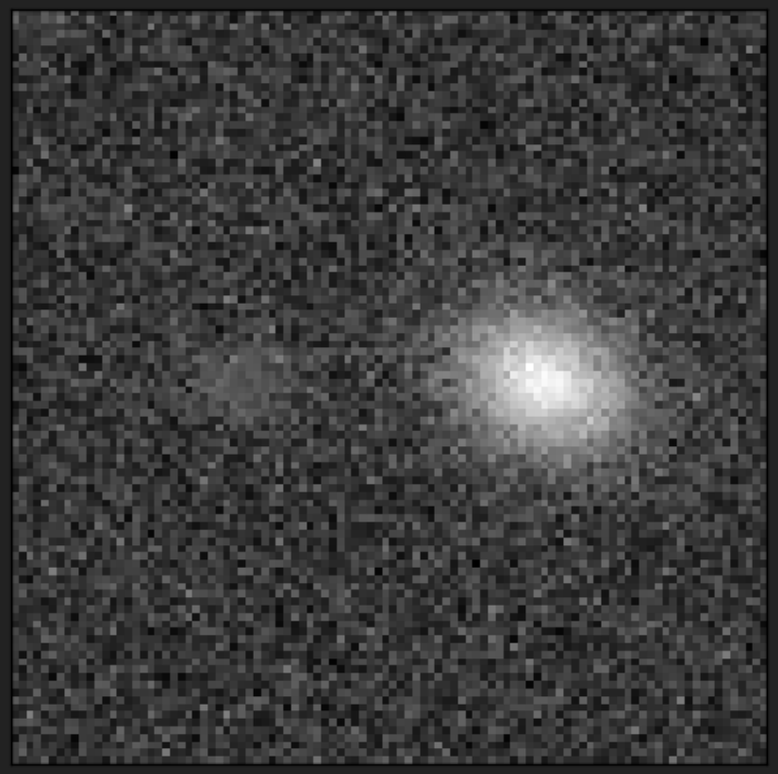






2) MATCHED “APERTURES”



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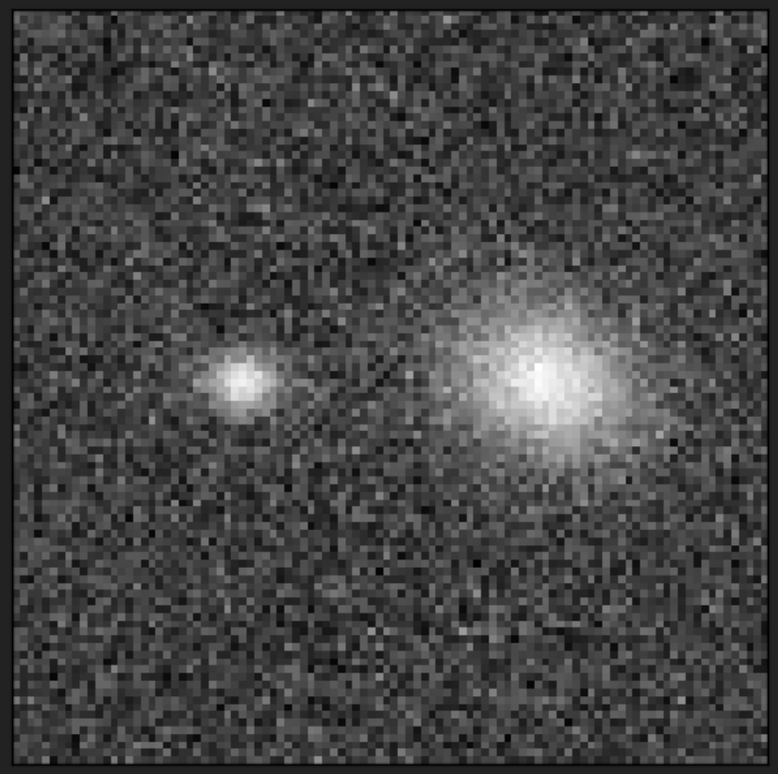

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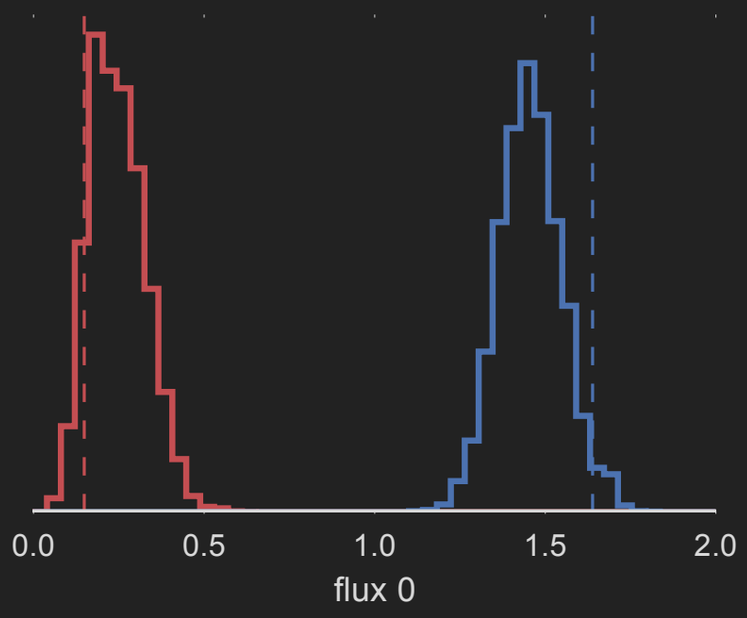

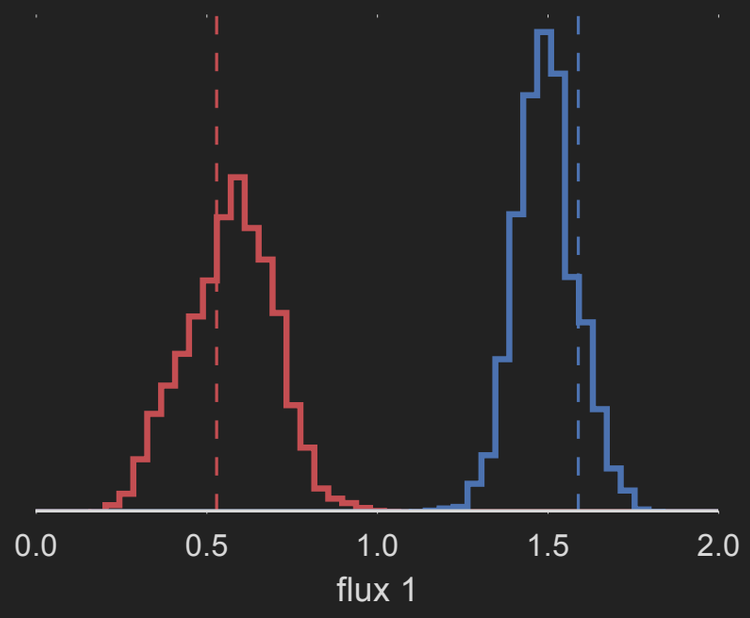

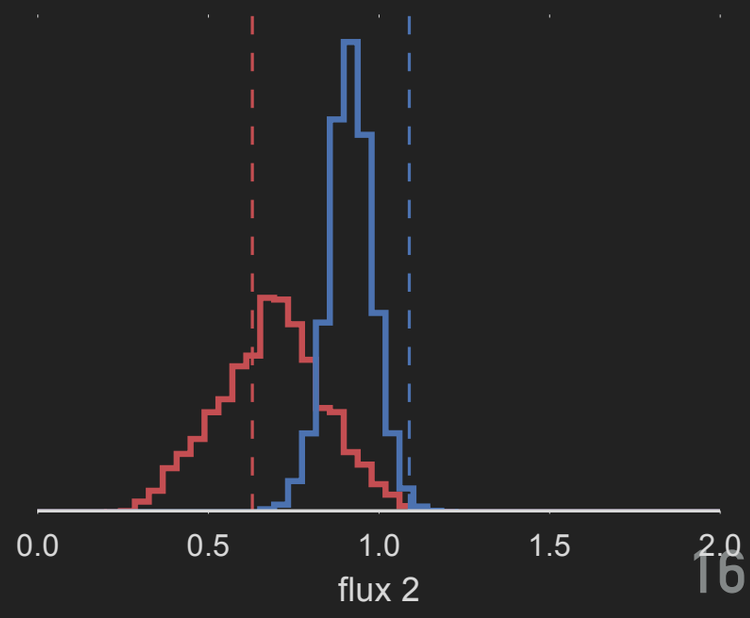

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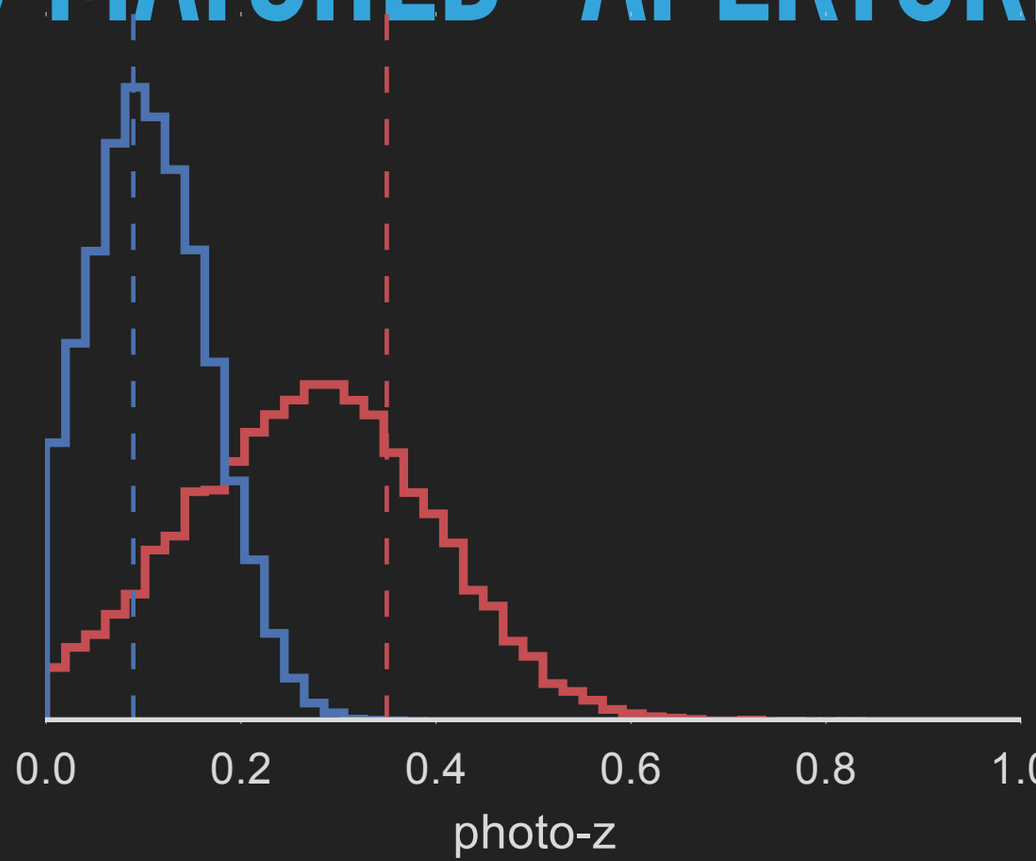
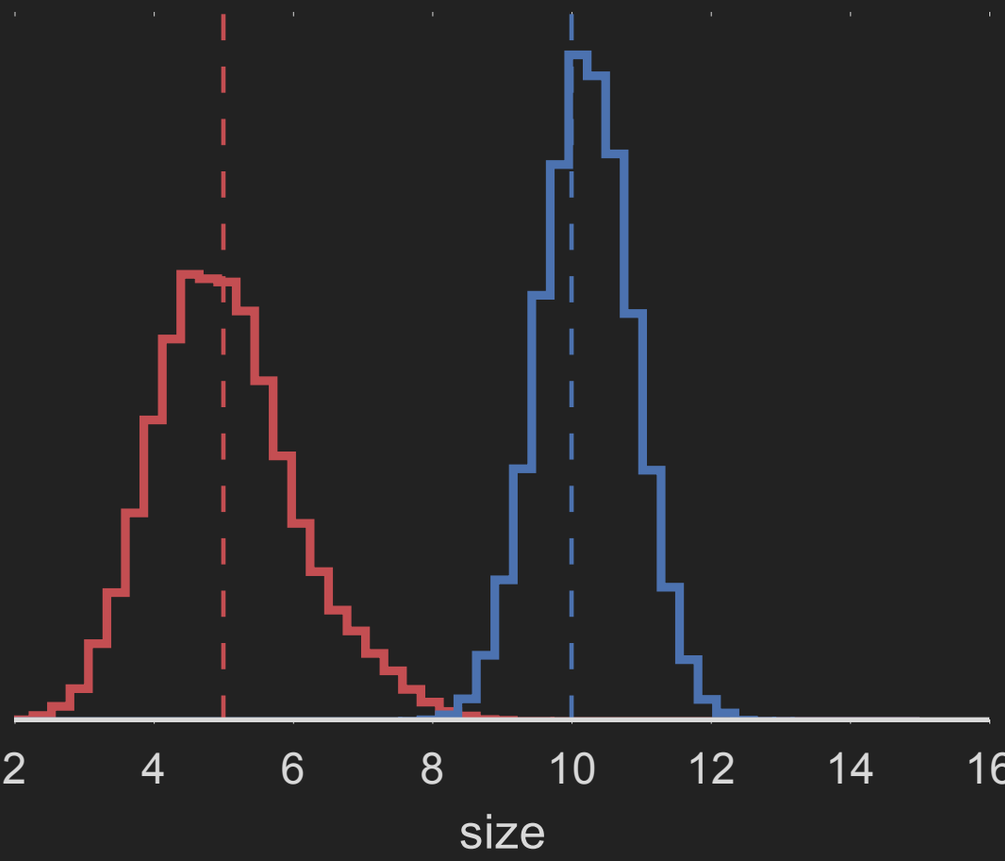
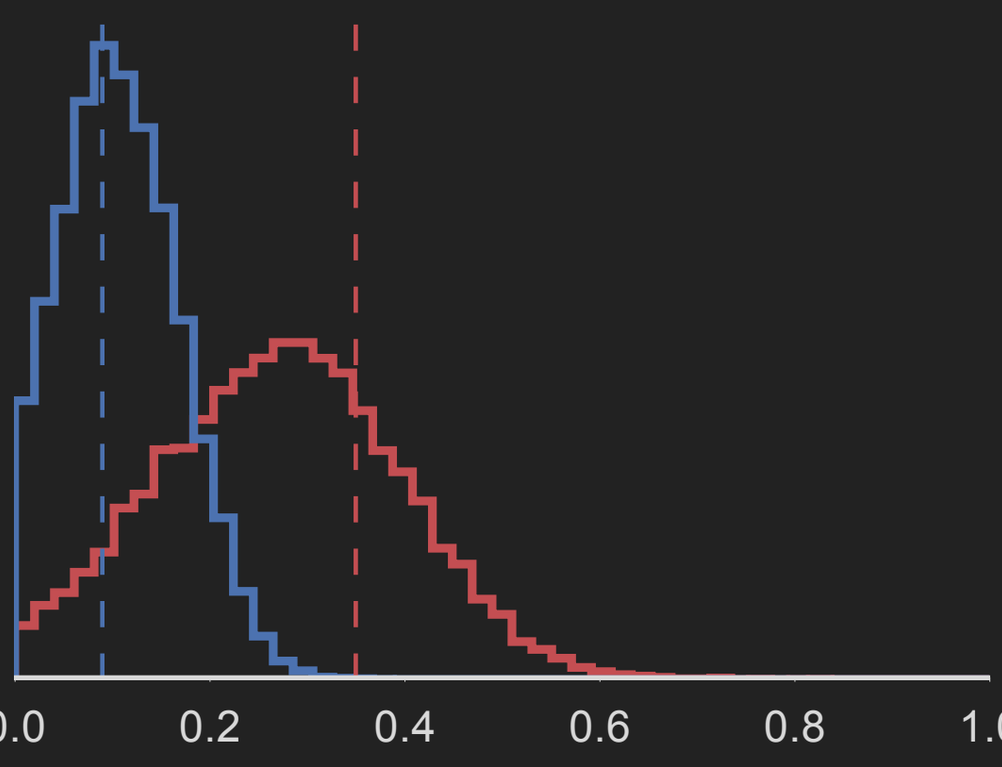
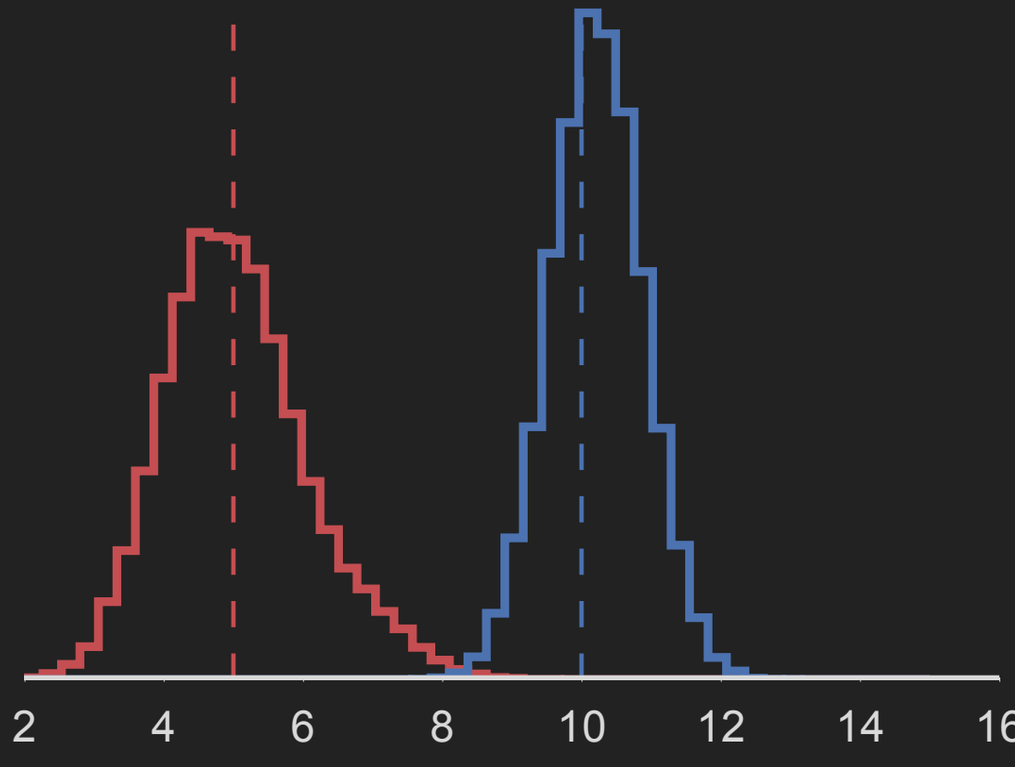




MATCHED APERTURE (PLUS JOINT PRIOR)

2)





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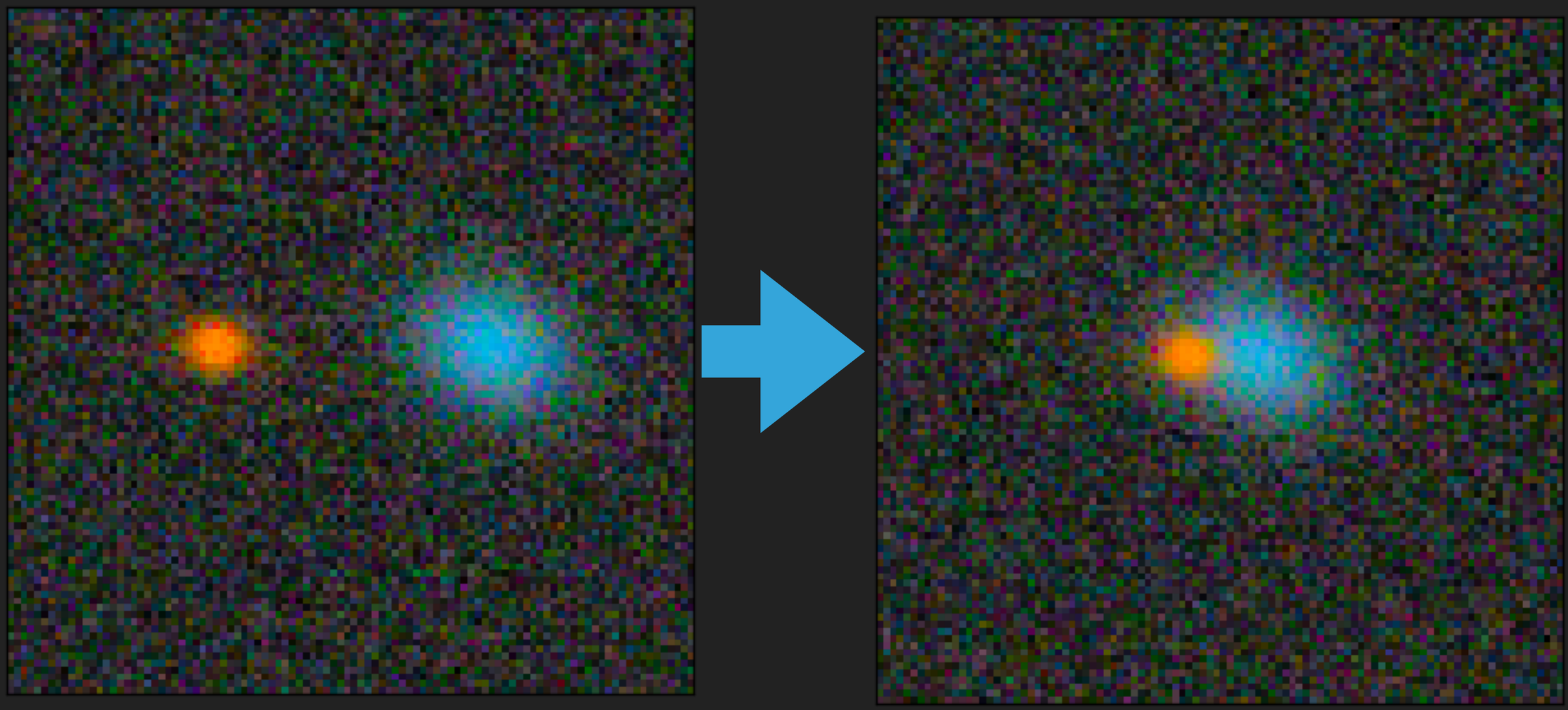
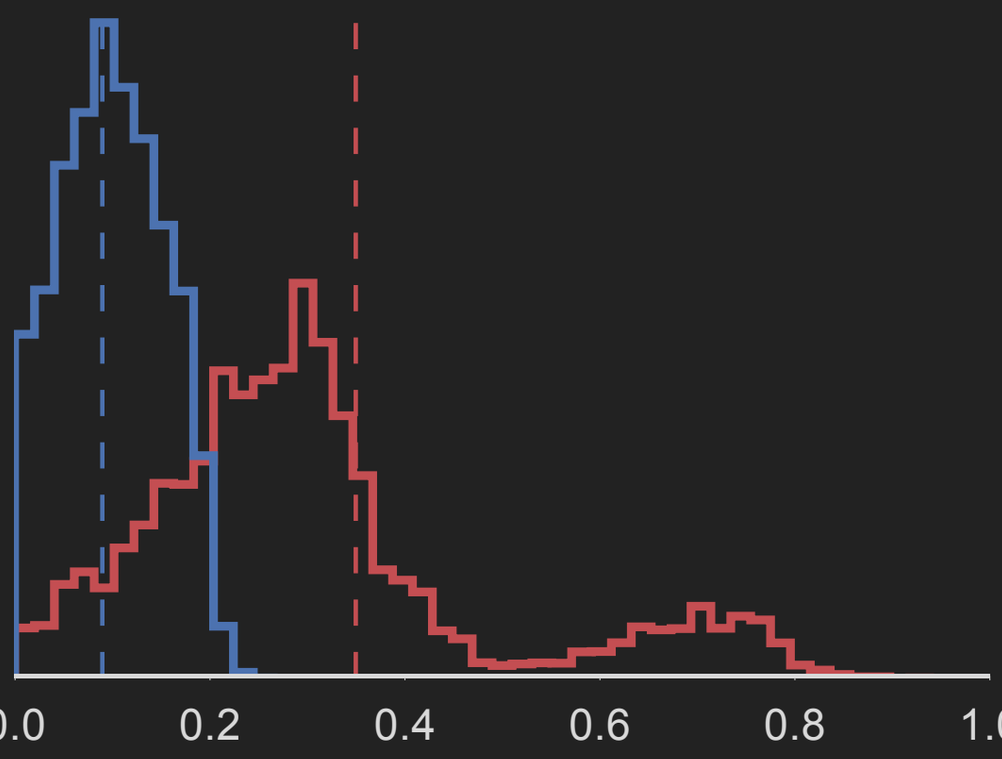
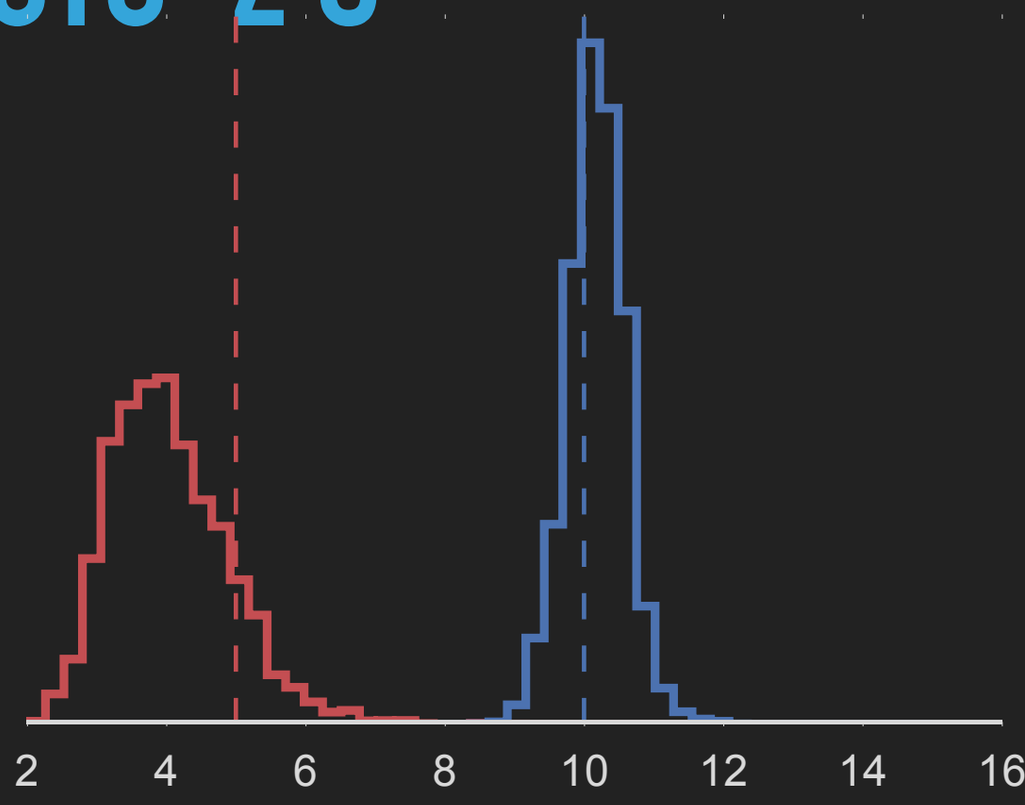
BLENDING



BLENDED SHAPES AND PHOTO-Z'S

2)





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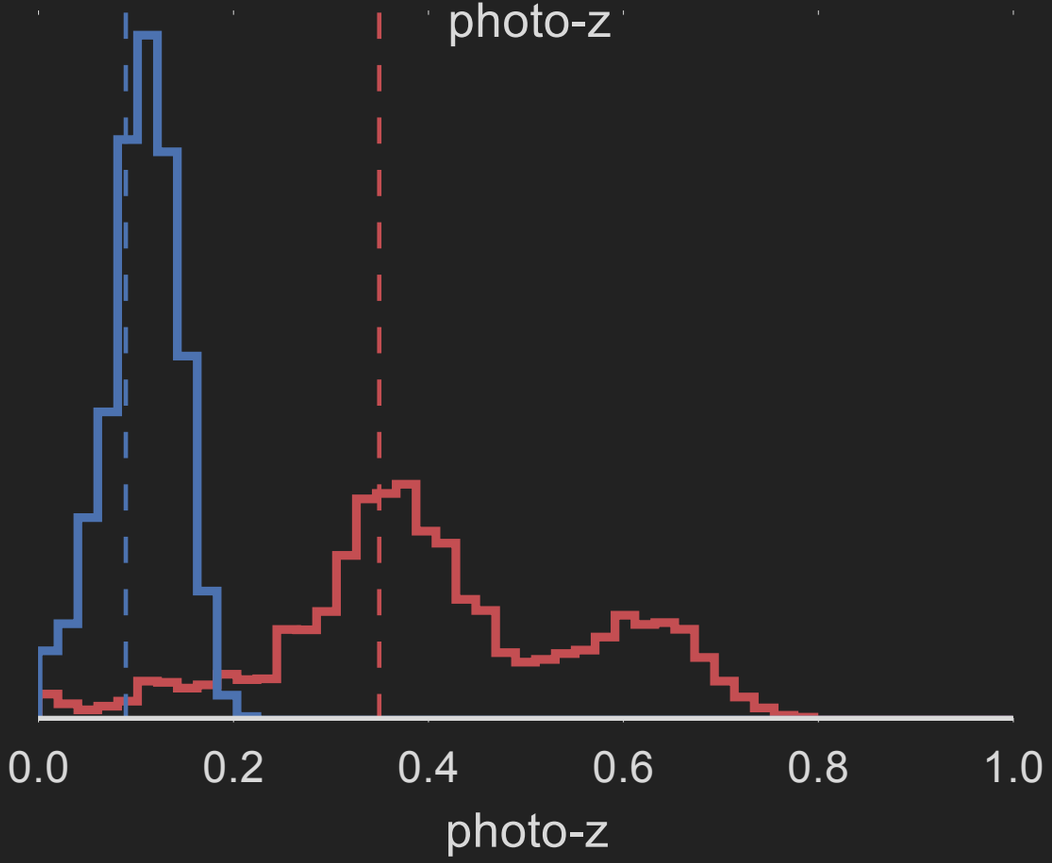
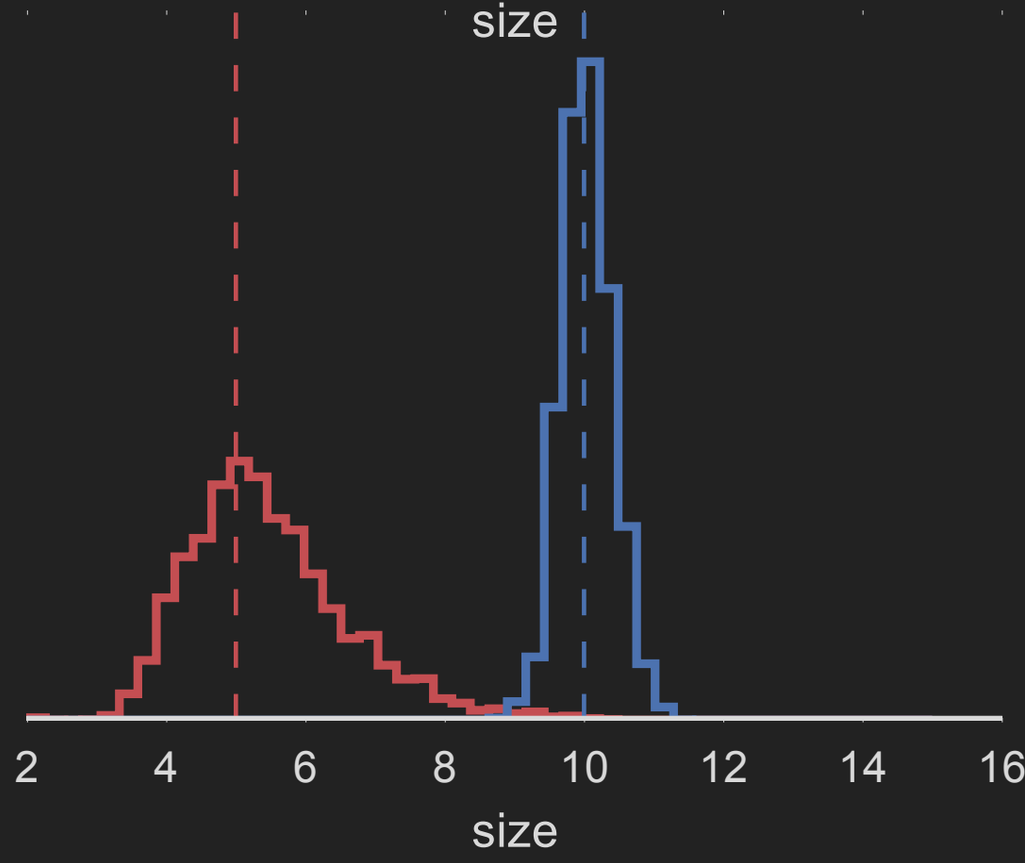


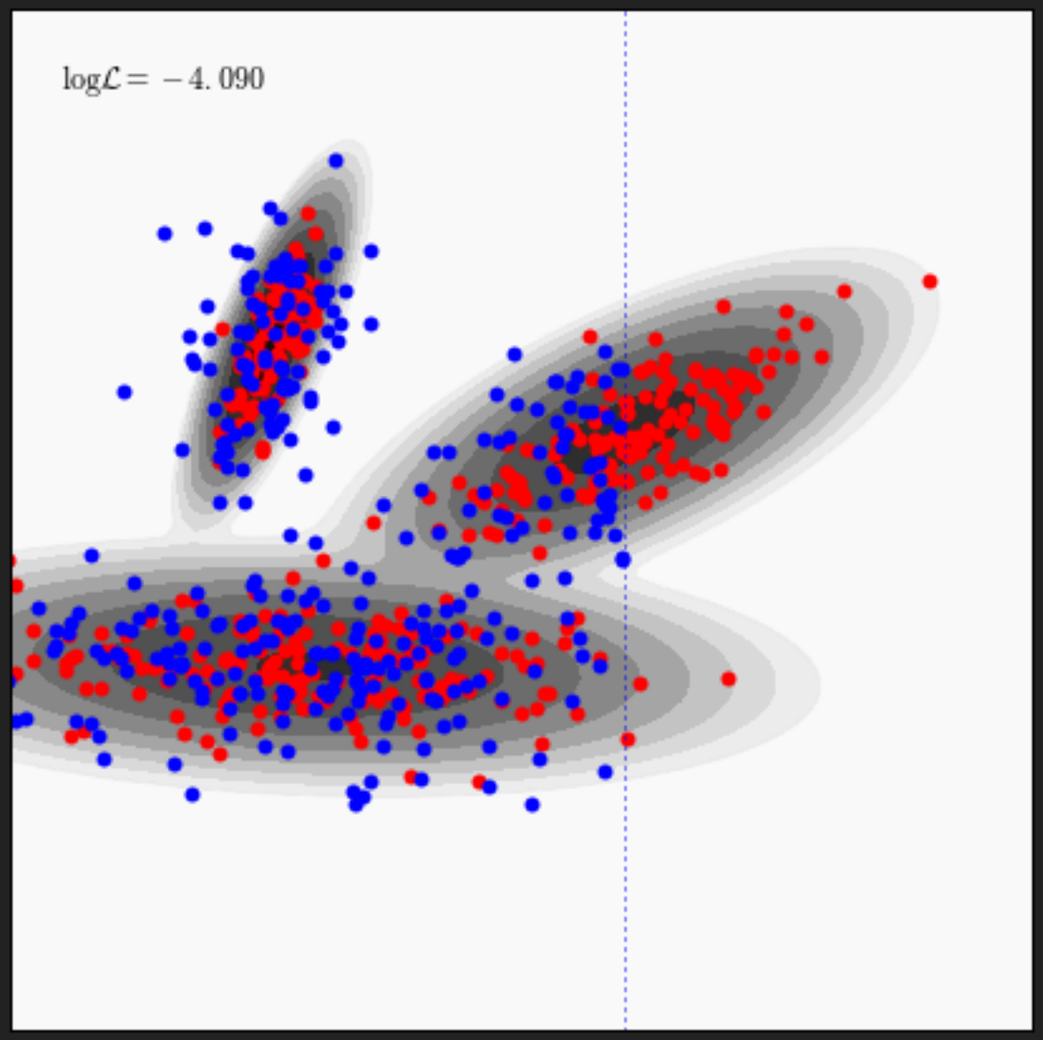


WHERE DOES THE PRIOR $p(A, \theta)$ COME FROM?

- LSST deep drilling fields
- With space-based imaging: precise shapes and blending detection
- Pixel-level joint analysis of LSST & WFIRST
- For LSST sans WFIRST: project out WFIRST amplitude space
  only LSST in likelihood, but LSST & WFIRST-derived priors
- But: How should we deal with blends? Or noise? Or incompleteness?

PRIORS: NOISE AND SELECTIONS

Gaussian-mixture model (Melchior, in prep.)
to correct for noise and selection effects



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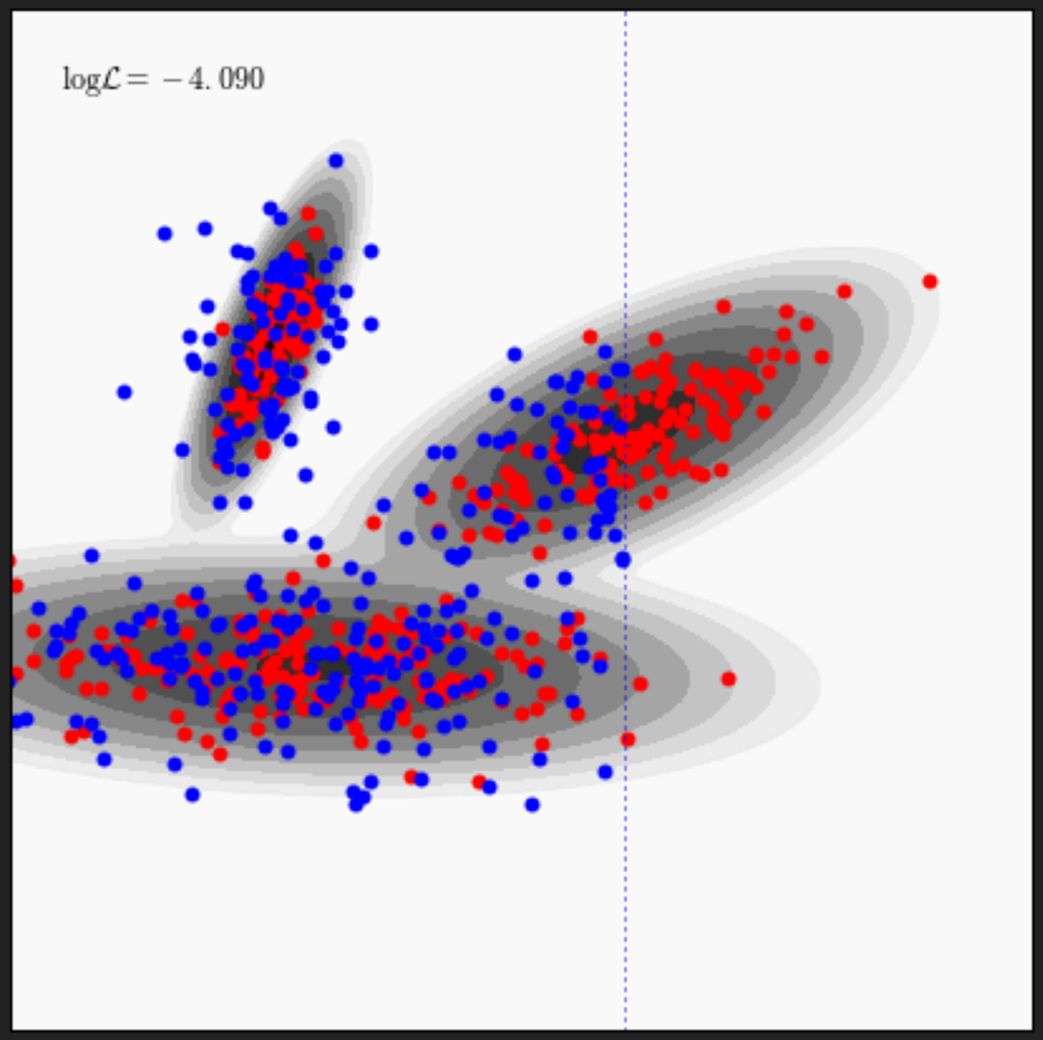

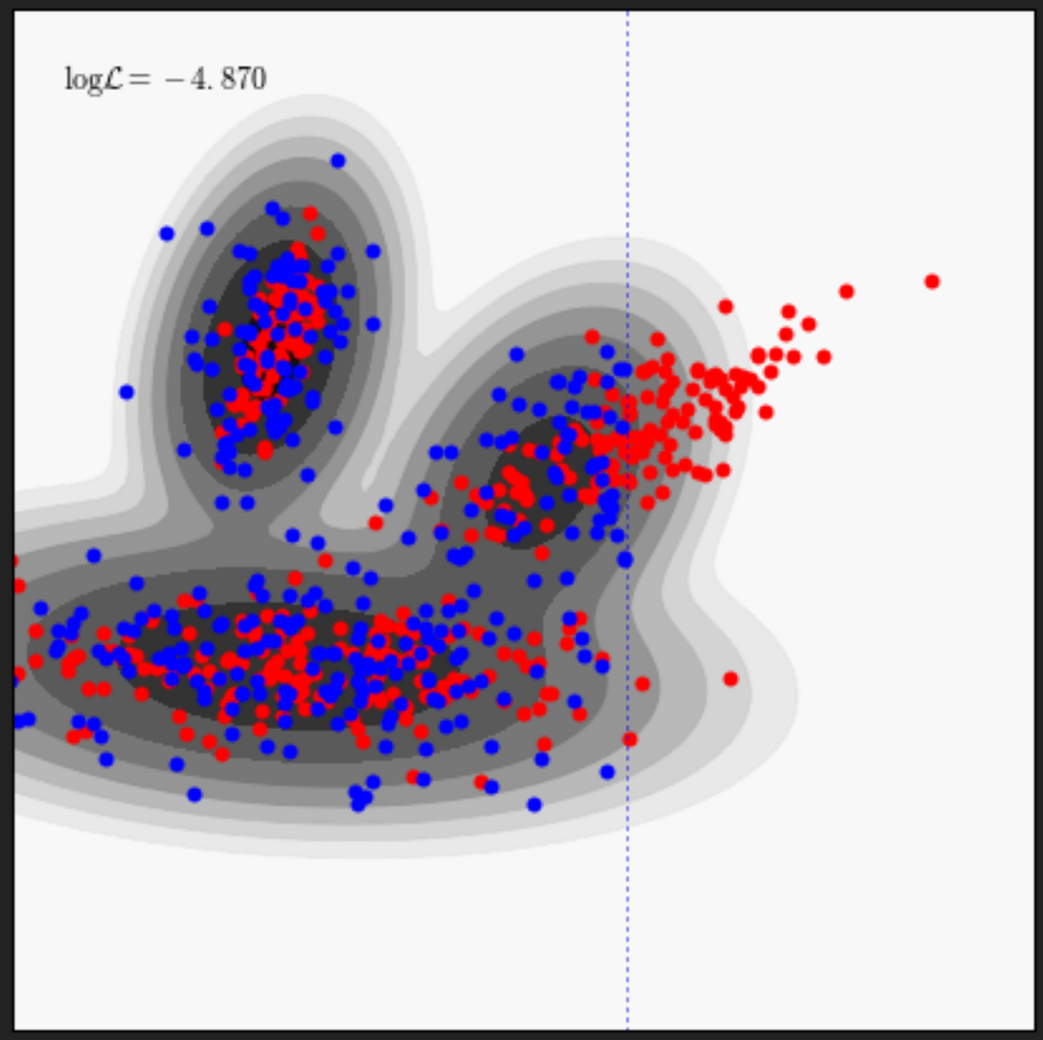

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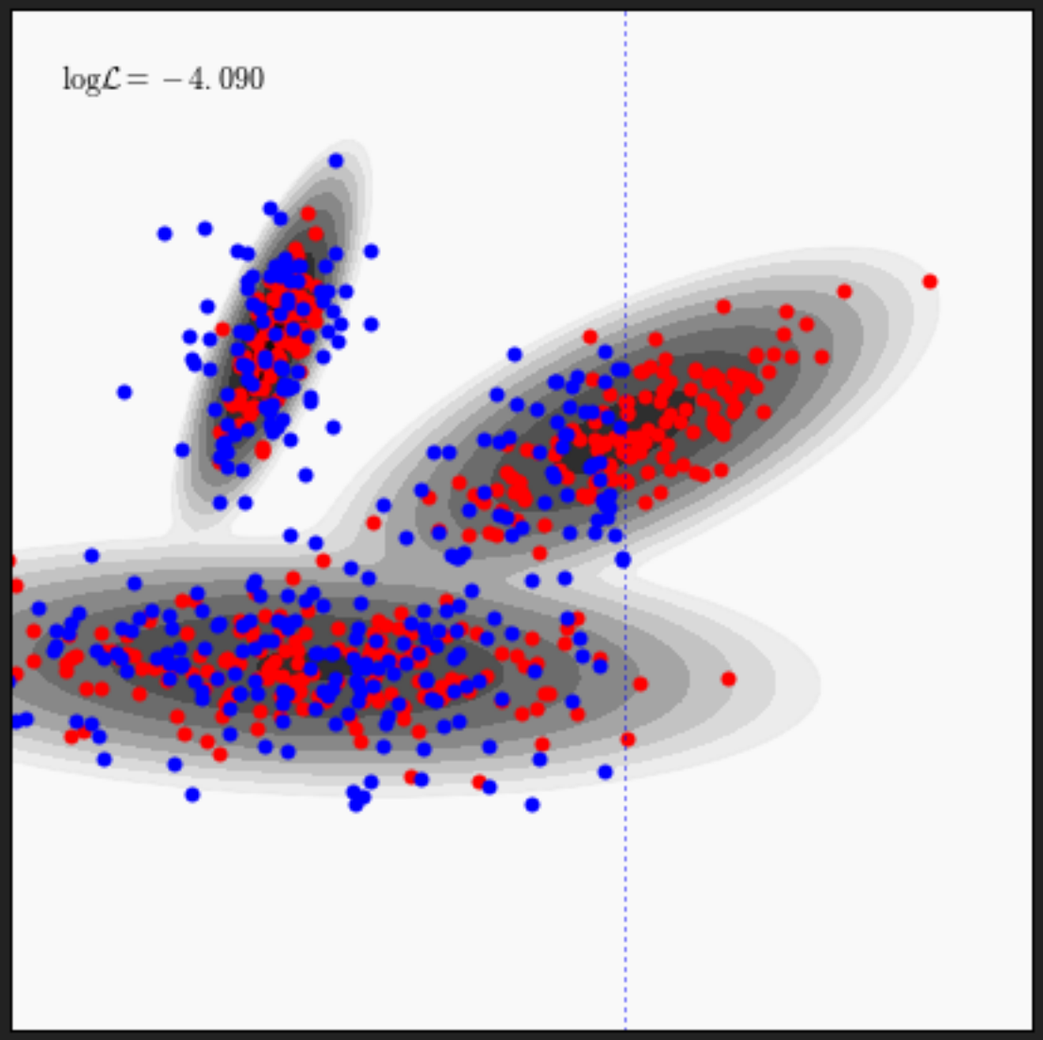
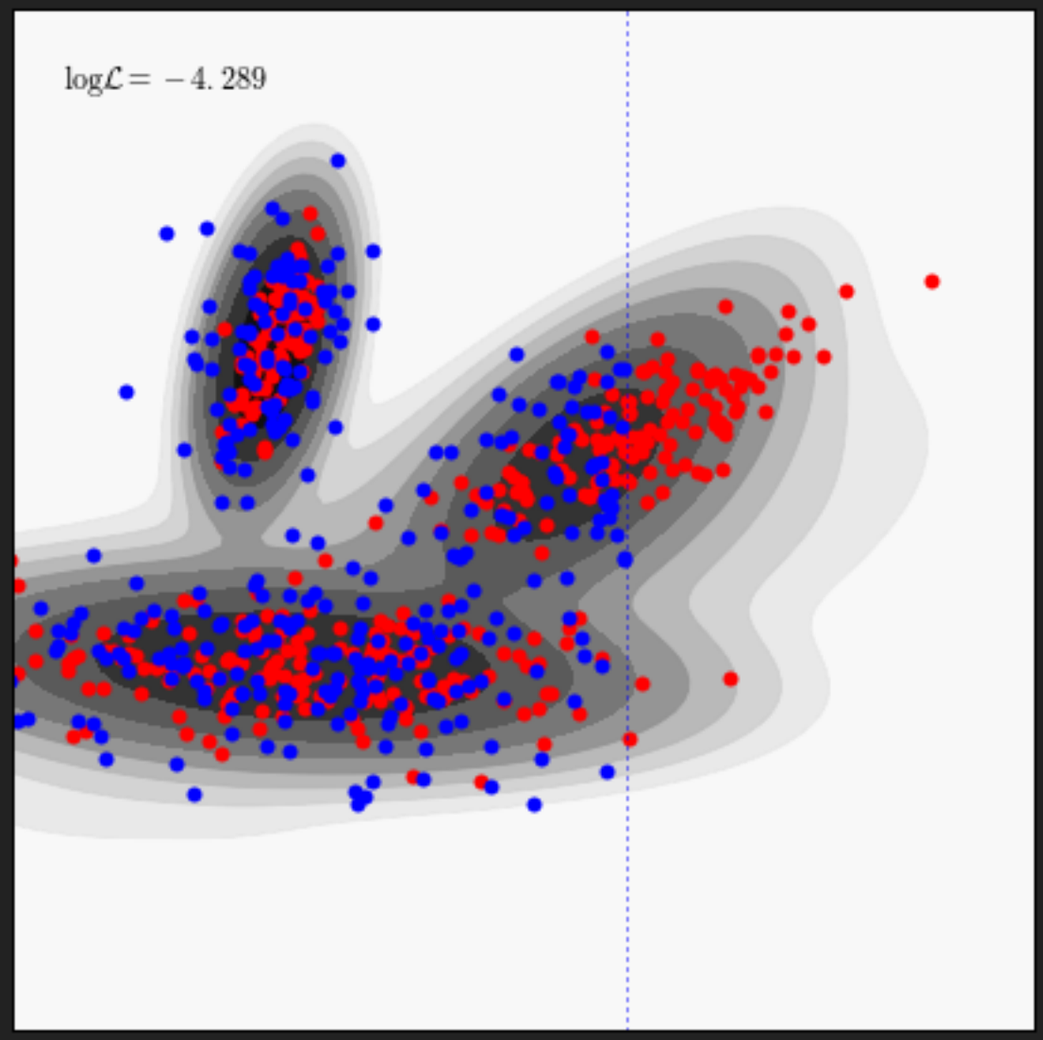
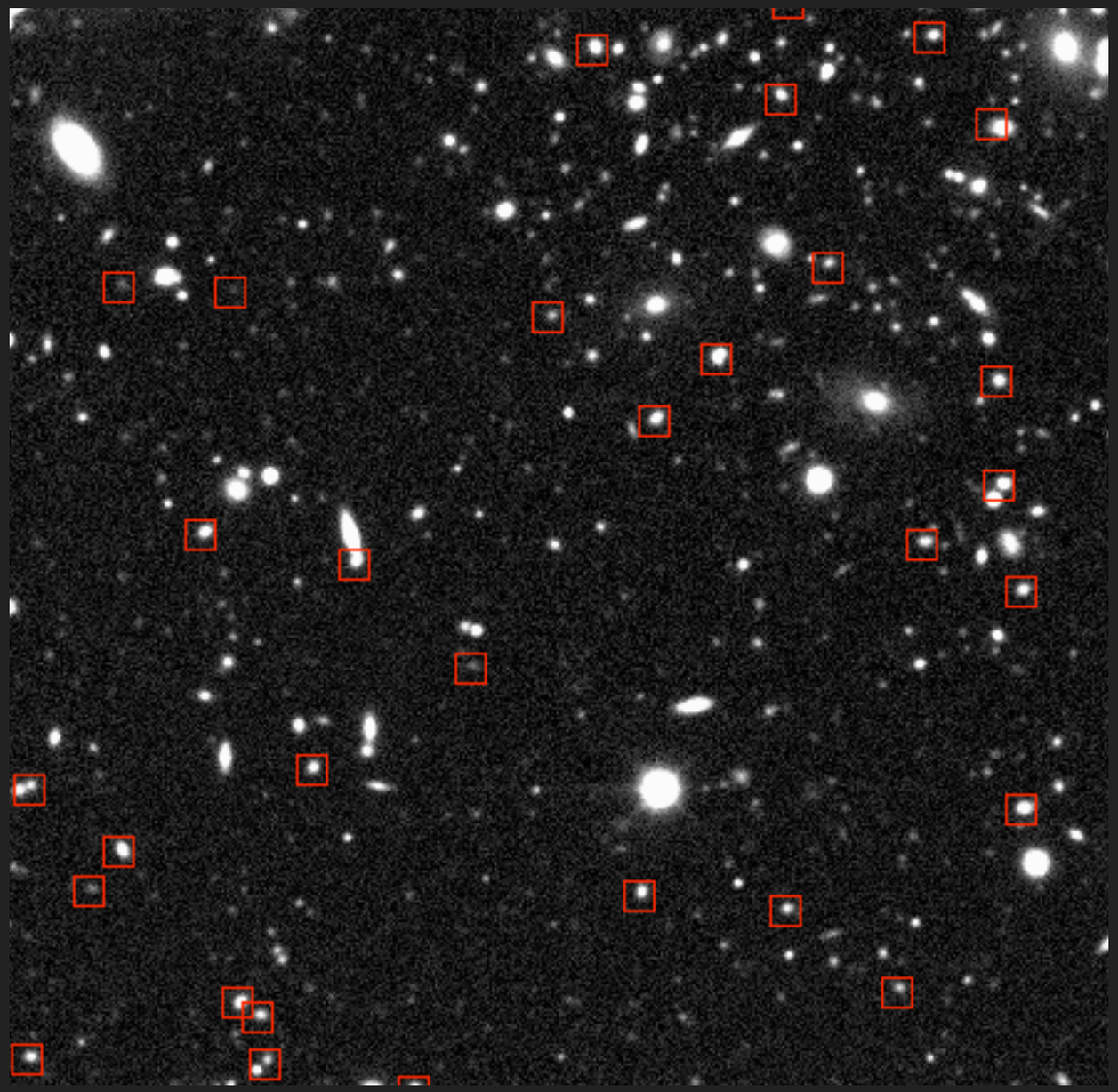


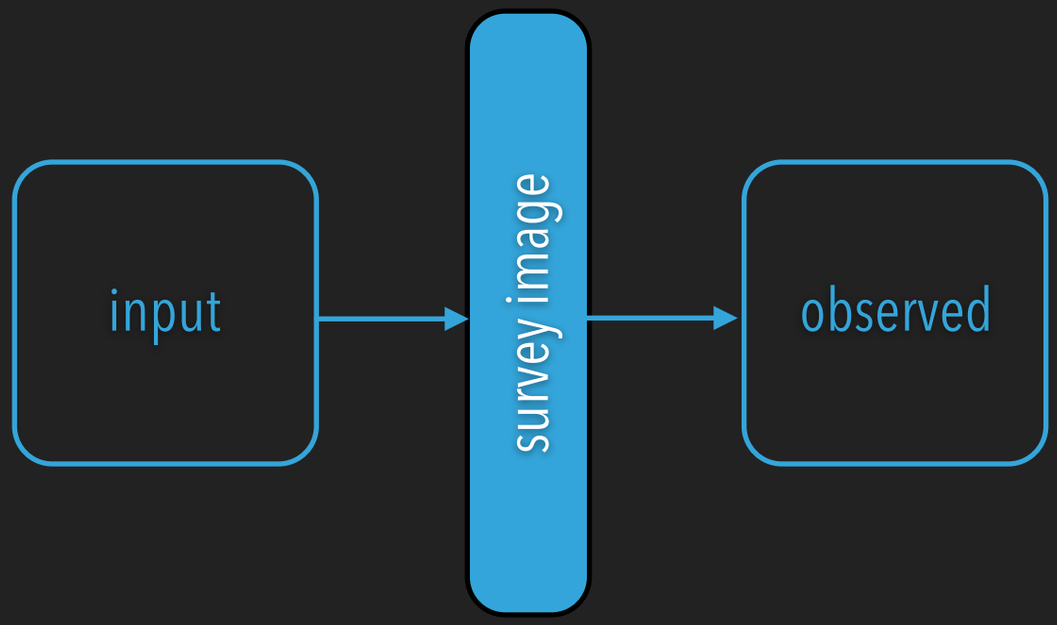


SELECTIONS: BALROG

SUCHYTA ET AL. (2016)



Inserting mock galaxies and stars into survey images



$$p(O \mid \theta, z)$$

JOINT PROCESSING OF LSST & WFIRST

- Joint detection (“Kaiser coadds")
- Joint measurement: particularly important to marginally resolved galaxies
- WFIRST: much better photo-z
- LSST: much better shapes in HLS overlap area
  Update of galaxy priors for area outside of HLS
- Minor addition to LSST computing budget
- LSST DM wants to enable maximum science utilization

ENJOY!